

"Engineering Education to meet Industry Expectations"

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Abstract

There has been continuous efforts to enhance the Industry and academia interactions in the Country but the progress is not yet satisfactory. Industry expectations from academia mainly are a) Having quality human resources with needed skills, good aptitude for team work and basic knowledge of system engineering and b)The academic programmes and curriculum have to stay aligned with their needs as far as possible

By and large Industries presently meet their human resource requirements by selecting the new entrants based on their attitude and then impart intense training to improve their skills needed for the job. There is a disconnect between the industry needs and the academia curriculum. The graduates from academia lack the capability to identify, formulate and solve engineering problems of products and systems needed by the Industries.

This gap can be substantially improved by introducing the realistic practical orientation to students by having close links with appropriate industrial establishments. It is also essential to design innovative laboratories at institutions to include state-of-the art industrial experiments. The major focus in academia is mostly in improving the knowledge in their area of expertise. They prefer strong research content and attempt to solve the problem by considering the multiple options.

Thus there exists a vast gap between Industry and academia. Industry focus is always production orientation with commercial viability. Their investment in research is very poor. The industry research, if any is need based, mostly application and economic oriented whereas academic research is always open ended, mostly peer reviewed and publication oriented. Therefore it is important to carry out the gap analysis periodically and try to align the curriculum and research to meet the industry needs without affecting the academic requirements. There is a strong need to set up a suitable mechanism to have continuous interaction amongst all stake holders to change the perceptions of research, technology development and production. Introducing the add-on lectures from industry experts on the subject, aligning with curriculum can be another important initiative. Arranging the visit for students in their final years to relevant identified Industries to expose them to practical applications of the subject they study has to be seriously considered.

Other important initiatives have to be to utilize the expertise of academia for Industry, to allow faculty members to come on sabbatical at Industrial establishments relevant to their area of expertise. Also establish a research wing in the Industry with enhanced funding and involve academic experts. One of the important initiatives is to set-up the Industry parks near the academic Institutions. Similar exercises have been done already by a few Institutions and they are yielding the desired results.

Keywords: engineering education, industry expectations from graduates, industry-academic partnership

Biography

Dr. BN Suresh is presently, President, Indian National Academy of Engineering (INAE), Delhi and Honorary Distinguished Professor at ISRO HQ, Bangalore. He was Director, Vikrm Sarabhai Space Centre and also Founder Director for the newly established Indian Institute of Space Science and Technology (IIST) at Thiruvananthapuram.

He is a fellow of several professional bodies like Indian National Academy of Engineering (INAE), Astronautical Society of India(ASI), Aeronautical Society Of India (AeSI) Indian Society of systems for Science and Engineering(ISSE) , International Academy of Astronautics (IAA) at Paris and System Society of India (SSI).

He was Head of Indian delegation for the United Nations Committee on Peaceful Uses of Outer Space at Vienna, Austria during 2004-07. He was selected as Chairman of the prestigious United Nations Scientific and Technical Committee for the year 2006 from the Asia Pacific Countries.

He has won several awards & honours and prominent among them are “Outstanding Achievement Award” by Department of Space, Govt of India, “Lifetime Contribution Award” in engineering by Indian National Academy of Engineering (INAE) for his significant contributions for space technologies “Aryabhata Award” the highest award by Astronautical Society for his invaluable contributions for aerospace developments “Karnataka State Rajyotsava Award” for 2014 for Science & Technology, the top award from Government of Karnataka and “Life time Achievement Award” from Karnataka State Science and Technology Academy in 2015

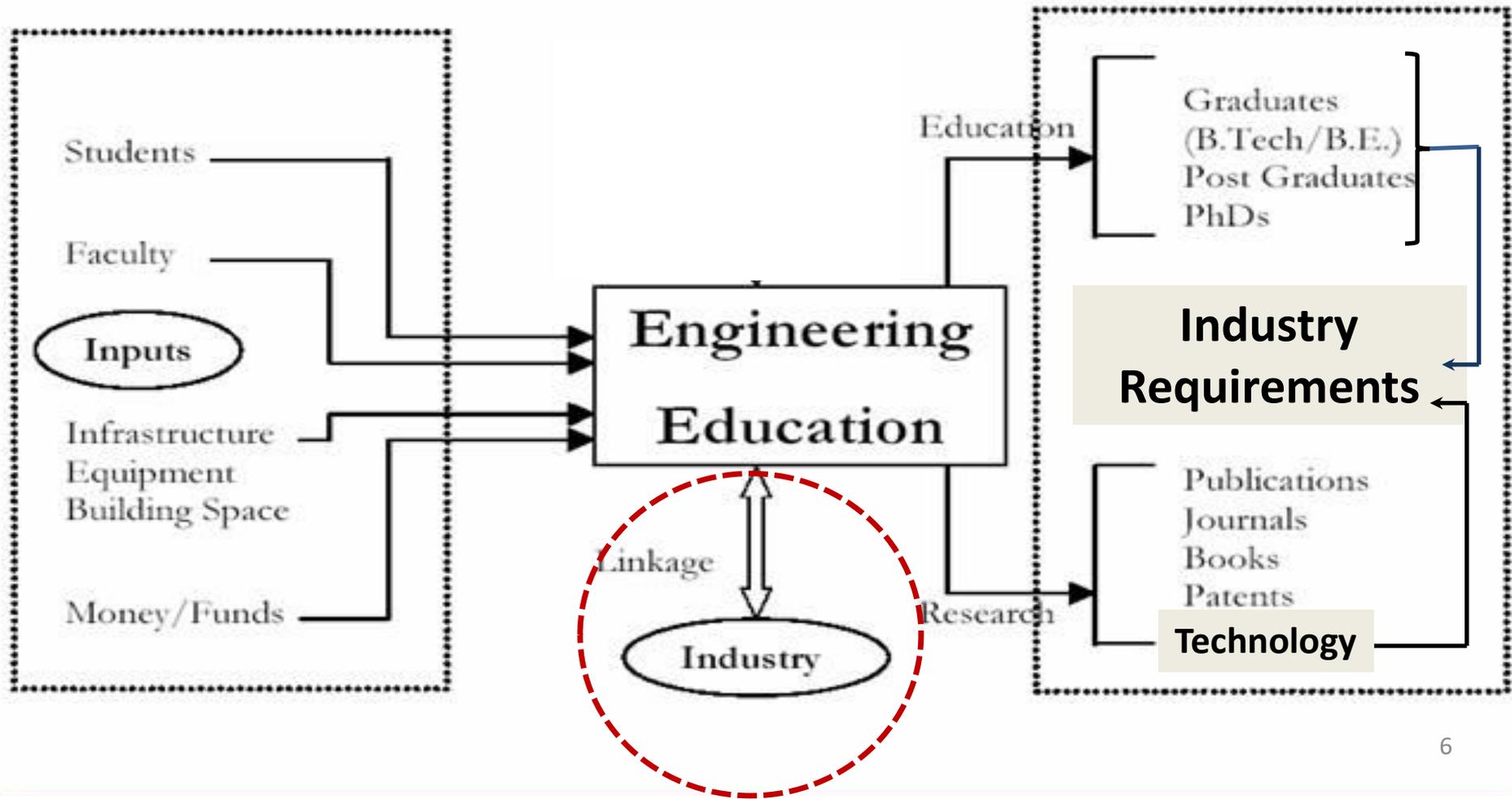
In recognition of his meritorious contributions for Science and Technology, Govt. of India conferred on him “Padmasree” during the year 2002 and “Padma Bhushan” during the year 2013.

Industry Expectations

- ❑ Expects quality human resources with needed skills, good aptitude for team work and basic knowledge of system engineering
- ❑ Wants academic programmes and curriculum to stay aligned with Industries needs to the extent possible.
- ❑ Looks for inputs from academia in specific designs, process improvement and also bettering the machine performance
- ❑ Participation in technology development which requires specific research or development work.
- ❑ Use of specialised Labs in Academia for developmental and testing requirements.
- ❑ Involvement in long term research needed by Industry.

Linkage with Industry and Education

Input-Output for Engineering Education



Electromagnetic Education

- ❖ **Concerns with the study and application of electric and magnetic fields**
- ❖ **Basically the electrical engineering and applied electromagnetics are closely connected. Covers widely:**
 - **Circuit Theory**
 - **Kirchhoff's Voltage and Current Laws**
 - **Current / Resistance**
 - **Capacitance / Inductance**
 - **Voltage**
 - **Electric and Magnetic Energy**
 - **Power, Electric Machines**
 - **Antennas, Waves and Wave Propagation, Optics and Optical Computing**
 - **Many more....**

Electromagnetic Applications

- With smaller devices which have high frequencies, circuit theory is not adequate to describe the performance or to predict the operation of circuits.
- At very high frequencies, transmission line and guided wave theory is needed: For ex. high speed electronics, micro/nano electronics, integrated circuits.
- Various applications of Electromagnetics -
 - *Fiber Optics*
 - *Microwave Communication Systems*
 - *Antennas and wave propagation*
 - *Optical Computing*
 - *Electromagnetic Interference, Electromagnetic Compatibility*
 - *Biology and Medicine/Medical Imaging*
 - *Many more*

Electromagnetic Education and Industry needs

- With the increased use of the electromagnetic frequency spectrum, the demand for engineers with a good practical knowledge of electromagnetic grows.
- Electromagnetic engineers have to be trained to carry out the design in high frequency or optoelectronic circuits, antennas and waveguides; electrical circuits to function properly in the presence of external interference and not to interfere with other associated equipment.
- The electromagnetic engineers have to be equipped to meet the needs of the industry in the areas of radar, antennas, fiber optics, high frequency circuits, electromagnetic compatibility and microwave communication and all other associated areas.

Electromagnetics : A Few Research Areas

1. Numerical Electromagnetics: Integral equation techniques

Application of fast methods to simulate the larger complex electromagnetic field problems.

2. Antennas and Propagation: Wearable antenna systems and body-centric communication

The theoretical and experiment research on wearable multi-antenna communication systems, exploring the application of diversity and MIMO schemes to improve the reliability.

3. Electromagnetic Compatibility and Signal/Power Integrity

Field of Electromagnetic Compatibility , in the context of electromagnetic immunity and emission models for ICs.

4. Inverse scattering and remote sensing

Development of algorithms and experimental research in the domain of inverse scattering and remote sensing.

5. Model order reduction

In the domain of rational frequency-domain modeling and model order reduction techniques for state-space systems derived from Maxwell's equations using rational orthonormal bases.

Human Resource Skills needed for Industries

- ❑ Abilities to apply knowledge of engineering or management sciences for development or overall management.
- ❑ Knowledge and aptitude for product and systems, facility build up, management of plants and facilities.
- ❑ Meeting the production needs understanding the quantity & quality requirements, the economic, constraints, environmental aspects and other related issues.
- ❑ System knowledge and teamwork skills to function on multidisciplinary systems.
- ❑ Capability to identify, formulate and solve engineering problems of products and systems of the Industry.
- ❑ Self education and continuous learning relevant to the products, systems and management.
- ❑ Use of various techniques, skills and modern tools for engineering development and enhancement of production.

Possible Actions to meet Industry HR Needs

- ❑ To give realistic practical orientation maximally by having close links with appropriate industrial establishments
- ❑ Design of innovative laboratories at institutions to include state-of-the art industrial experiments
- ❑ Focus on hands-on industrial experience with 'real life' experiments linking with curriculum right from day one.
- ❑ To set up suitable mechanisms to promote continuous interactions.
- ❑ Creation of “virtual” laboratories to mimic industrial environment, which can be funded from industry.
- ❑ Some of these suggestions are being practiced at IIST an Institute of Space Department.

Understanding the Academic Aspirations

- ❖ Academic focus is by and large the addition of knowledge in their area of expertise.
- ❖ Prefers the research content and tries to solve by considering the multiple options. Time consuming.
- ❖ Research leads to publication of papers or filing the patents rather than realising the proto products in deliverable form.
- ❖ Question of patent rights where joint industry academia research is involved.
- ❖ Lack of interest or experience in transforming the Lab to technology development and to commercially viable production.

Gap between Industry expectation and Academia

- ❑ Industry focus is always production orientation with commercial viability. Investment in research is very poor.
- ❑ HR needs are met by attitude based selection and impart intense training for the needed skills.
- ❑ The industry research, if any is need based, mostly application and economic oriented.
- ❑ Academic research is always open ended, mostly peer reviewed and publication oriented.
- ❑ Minimal interaction between academia, R&D engineers and industries in education and research projects.

How to bridge this Gap between Industry and Academia

- ❑ Suitable mechanism to have continuous interaction to change the perceptions of research, technology development and production
- ❑ Carry out gap analysis periodically and tune the curriculum to meet the industry needs without affecting the academic requirements.
- ❑ Introducing the add-on or guest lectures from industry experts on the subject they learn aligning with curriculum.
- ❑ Arranging the visit for students to relevant identified Industries to expose them to practical applications of the subject they study.
- ❑ Seek the help of Industries in procuring the suitable equipment and machineries. Industries can even provide the old working equipments to academia.

Suggested Practical Solutions

- ❑ Faculty members to go on sabbatical at Industrial establishments relevant to their area of expertise
- ❑ Establish a research wing in the Industry with enhanced funding and involve academic experts
- ❑ Joint development of advanced products needed by Industry in collaboration with academia.
- ❑ Introduce Industry experts in committees which frame academic programmes.
- ❑ Setting up Industry parks near the academic Institutions. (These exercises are successful in a few Institutions)

Thank You